Writers: Eija Hagelberg (Baltic Sea Action Group), Ulrika Wikström (Baltic Sea Action Group),
Juuso Joona (University of Helsinki /Tyynelä farm), Tuomas Mattila (Finnish Environment Institute /Kilpiä farm)

2020

Regenerative Agriculture:
A new direction of food production

Regenerative agriculture is an emerging holistic approach to food production that strengthens the ecosystem. In addition to producing good yields of high-quality, the management practices also improve soil health (Figure 1), increase biodiversity and contribute to sustainable management of water and waterways. The storage of atmospheric carbon back into the soil is one of the identified benefits of regenerative agriculture. In Finland, the Carbon Action platform, launched by the Baltic Sea Action Group, is one of the foremost groups promoting the principles and measures of regenerative agriculture. The increasing of carbon stocks while producing food is also referred to as “carbon farming”.

Figure 1. Soil health affects crop yields and carbon storage, among other things. A faba bean seedling. Photo Eija Hagelberg

The aim in regenerative agriculture is to improve the functioning of local agroecosystems through suitable farming practices. An abundance of scientific research on the practices and environmental benefits of regenerative farming illustrate how it can be applied in different circumstances. When properly selected and applied, regenerative agriculture practices increase soil organic matter stocks and reduce dependence on external inputs while concurrently reducing environmental emissions and increasing biodiversity. Regenerative agriculture practices can be applied in the same way in both conventional and organic production. In addition to these environmental benefits, regenerative farming also aims for good and secure harvests of high nutritional quality.

Farmers interested in soil management are already working according to the principles of regenerative agriculture. As crop yields have stagnated in recent years under conventional agriculture, regenerative agriculture has gained popularity as many farmers look for new perspectives and alternative methods. Farmers are looking for solutions that can simultaneously improve the profitability of the farm and the functioning of the soil. In the long run, regenerative agriculture can increase the profitability of agriculture and, thus, the economic sustainability of food production. It is important for regenerative agricultural products and their markets to strive for diversity, crop security and adequate yield levels.

Soil management combines different definitions of regenerative agriculture

Soil management combines multiple definitions of regenerative agriculture. Regeneration refers to the process of healing damaged tissue and is also used in ecology to describe the recovery of an ecosystem from a severe disturbance. The opposite of the word regenerative is degenerative. The state of the system living in it is gradually deteriorating. In between these two there is the sustainable state. (Figure 2).

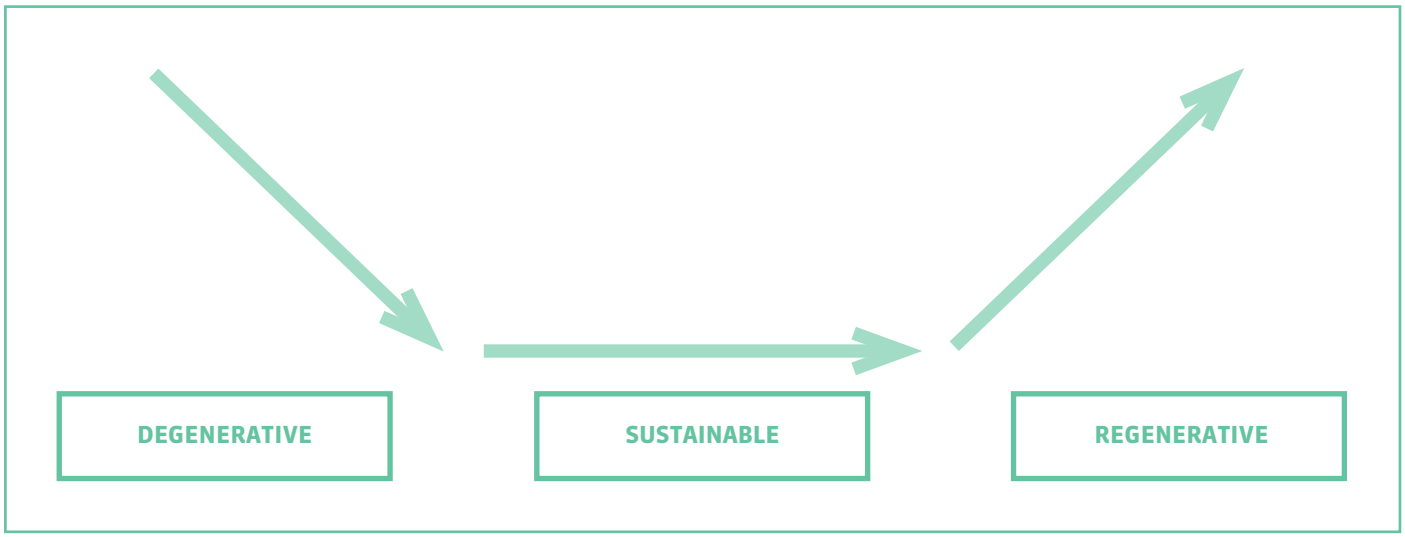

Figure 2. A food production system can either degenerate, sustain or regenerate its operating environment. Which direction do we choose?

'Regenerative agriculture' can be defined in various ways. In its broadest sense, it includes not only agricultural ecosystems, but also social sustainability and animal welfare, and the education of new generations of farmers. Broadly defined, regenerative agriculture can almost be seen as a synonym to the agroecological approach. At the other end of the spectrum, the definitions are strictly limiting, and include fewer farms. For example, the Rodale Institute's Regenerative Organic Agriculture certificate only covers organic farms that use minimal tillage and catch crops.

However, most definitions, among them the one used on the Carbon Action platform, emphasize the management of agro-ecosystems, with soil management at the forefront. The definition, which focuses on soil health, makes it possible to develop farm sustainability regardless of farm production type and method of production. A good example of a soil-centred definition is the list of six core principles presented by General Mills to its producers (Figure 3).

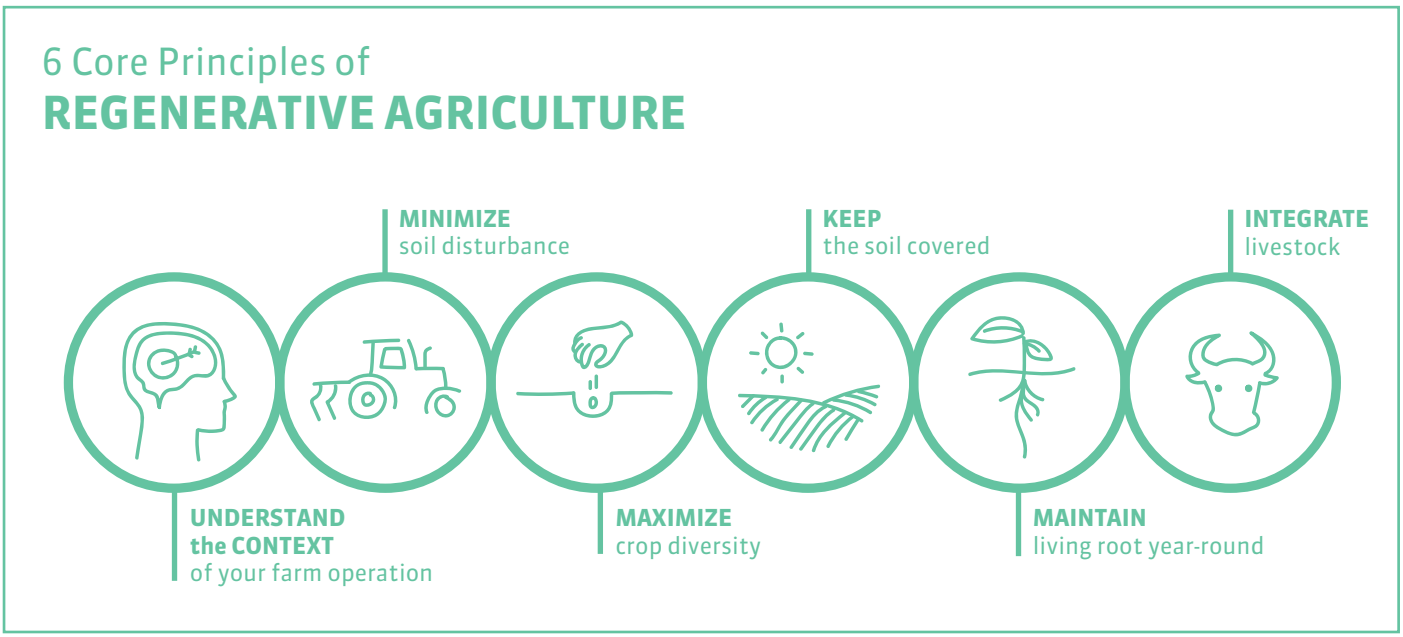

Figure 3. A good example of the progression of regenerative agriculture globally is the goal of the American food giant General Mills to implement regenerative agriculture on 1,000,000 acres (about 405,000 hectares) by 2030.

General Mills' definition of regenerative agriculture includes six core principles:

1. *Understand the context of your farm operation*
2. *Minimize soil disturbance*
3. *Maximize crop diversity*
4. *Keep the soil covered*
5. *Maintain living root systems year-around*
6. *Integrate livestock*

https://www.generalmills.com/en/Responsibility/Sustainability/Regenerative-agriculture

Other useful definitions of regenerative agriculture:

The Carbon Underground
https://secureservercdn.net/184.168.47.225/02f.e55.myftpupload.com/wp-content/uploads/2017/02/Regen-Ag-Definition-7.27.17-1.pdf

Regenerative Organic Certified www.regenorganic.org

Terra Genesis International www.regenerativeagriculturedefinition.com

A common feature of all definitions is the strive towards a more diversified and integrated agricultural production system compared to current conventional agriculture, which is characterized by the separation of livestock and crop production, as well as monoculture, external inputs and intensive tillage. Agricultural development has made it possible to feed a growing population with the help of fewer farms, but the condition of the soil and arable ecosystem has been overlooked. Soil compaction, degradation and erosion all affect yields and the continuity of production and have prompted producers to look for farming methods that improve soil health. By using regenerative agricultural practices, farmers can pass on their fields with ever healthier soils to the next generation.

The agroecological approach

In the agroecological approach, food systems are treated holistically and developed towards ecological, economic and socio-cultural sustainability. The approach views agricultural production as part of the agroecosystem.

The production is based on an understanding of the functions and effects of the ecosystem. Production methods are based, among other things, on the sustainable use of local resources, the support and use of ecosystem services, and the most multi-beneficial and comprehensive solutions possible for the sustainability of the entire food system. The agroecological approach also considers the diversity of different places and food systems with the aim of adapting the solutions to the resources and constraints of each location and system.

Regenerative farming

Soil management is at the heart of regenerative agricultural systems. It is through a soil management perspective that we talk about regenerative farming. It is farming that improves soil health, recycles nutrients, increases soil carbon stocks and promotes biodiversity. The term carbon farming is used to emphasize the carbon-storing properties of the methods used in regenerative agriculture.

Practical methods for soil regeneration

Healthy soil with a good structure is a farmer's most important asset. Achieving good soil structure can take years and can be lost in an instant. Driving a heavy tractor on wet soil is likely to cause damage that will not repair on its own. Soil compaction causes many problems: plant roots cannot develop normally, soil organisms are few, there is little air space and water isn't stored. Regenerative agriculture begins with a plot-by-plot assessment to remedy compaction and other problems that weaken soil structure. Examples of suitable corrective practices include drainage, liming and subsoiling. A basic rehabilitation of the field is a necessary first step, after which the annual measures not only maintain the condition of the soil, but also further improve it. Good condition of the field is a prerequisite for carbon sequestration.

Once the field has been rehabilitated, its functions are further developed by maintaining a continuous living root system in the ground, keeping the surface of the field protected by litter and leaves, and increasing crop diversity (Figure 4). Continuous access to food and shelter allows the soil organisms to grow and the field ecosystem to develop. Disruption from tillage and the use of pesticides should be kept to a minimum, in other words, fields should be tilled lightly, and the pesticides used should be as harmless as possible. Perennial grasses in the crop rotation improve soil health. When managed sustainably, pastures and mowed grass leys store carbon in the soil. Ruminants can take advantage of grasslands and are therefore a necessary part of regenerative agriculture (Figure 5).

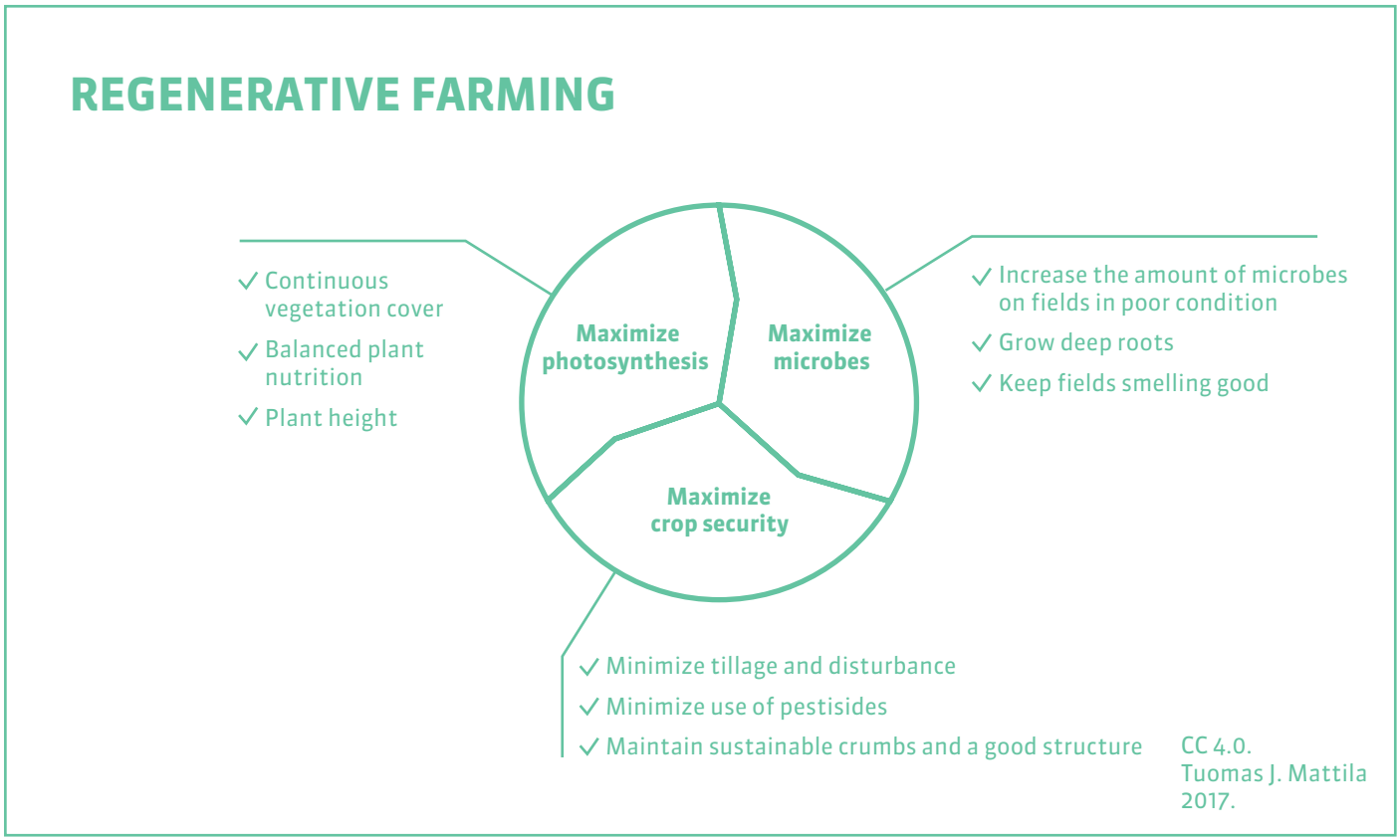

Figure 4: One good thing leads to another and creates a complete positive cycle. The three main principles of regenerative agriculture reinforce each other. Reference: Mattila, Joona and Regina, 2020.

Figure 5: Ruminants play a big role in regenerative agriculture, as they can feed on the grass leys essential to regenerative crop rotation. Compost and dried manure are good soil amendments. Sustainable grazing increases biodiversity and increases soil carbon stocks. Dairy cattle in Kärsämäki. Picture: Tapio Heikkilä.

The food system and its sustainability challenges

Agriculture and food systems face multi-level ecological, economic and socio-cultural sustainability challenges. Ecological sustainability challenges include, for example, climate change, biodiversity loss and severe changes in nitrogen and phosphorus cycles. Economic and socio-cultural challenges include low economic viability of agriculture, food security, unethical behaviour towards producers, workers and farm animals, demographic changes and associated food demands, and the challenges of human nutrition.

Regenerative agriculture offers solutions to sustainability challenges

Regenerative farming can make climate change mitigation and adaptation more effective. Regenerative farming increases the amount of carbon and organic matter in the soil, which improves soil structure and field productivity. At the same time, the resilience of the ecosystem increases and the ability of the soil to retain water, soil particles and nutrients improves. More resilient soils can better withstand climate change impacts like flooding and drought.

Preserving and increasing diversity is an important goal in regenerative farming. A diverse agro-ecosystem also provides habitats and food for organisms that support food production, such as soil organisms, pollinators and beneficial insects. The benefits of diversifying production include improved productivity and increased resilience to extreme weather conditions as well as plant diseases and pests. Diverse yields support diet diversification and improved nutritional quality. Living and healthy soils and diverse cultivation can improve the nutritional value of food. Local economies and closed nutrient cycles can be strengthened by buying from local regenerative farmers. This increases social sustainability as well as the transparency of food production.

Recommendations to support decision-making: How can regenerative agriculture be promoted?

For regenerative agricultural production to become more widespread, it is necessary to increase long-term research and research funding. More information is needed on the methods and benefits of regenerative agriculture in ever-changing climatic conditions and in different environments. However, there is no need to wait for the research results to be completed: there is already enough information on the benefits of regenerative farming methods to support their widespread adoption.

There is a great need to increase the interaction between the research and farming communities. Change in agriculture requires practical information and, in the scientific research, it is important to consider perspectives based on farmers' practical skills. For research to be applied the results must be made comprehensible and they must be relevant to the agricultural work. The role of advisory services is critical. Ensuring a high level of knowledge of advisors is crucial in putting research into practice.

To a wider extent, advisory activities should be carried out in small groups. Positive experiences have been gained in small group settings with farmers. The input of researchers should be utilized in this type of group advisory outreach. Everyone benefits from working together: advice is based on the latest scientific knowledge, and researchers are able to address issues that are relevant in practice.

Farmers' peer support and learning play a key role both in disseminating information as well as in creating an atmosphere that encourages experimentation and enables the development of new innovations and a new operating culture. Adopting new information from science and through peer-learning, and thereby increasing know-how, strengthens the capacity to develop farm operations and to adopt new farming practices.

The next EU Common Agricultural Policy (CAP27) and the EU Farm-to-Fork and Biodiversity strategies include individual goals such as reduction in fertilizer and pesticide use, which are in line with regenerative agriculture. The attainment of these goals should be supported with incentives for farmers. Incentives are needed not only in the eco-schemes and the agri-environment-climate compensation scheme, but also in investment support and information and cooperation measures. The details written in the program will influence farmers' choices in the coming years. Reform of incentives, such as the introduction of results-based payment schemes, could also help to introduce regenerative farming practices to more farms.

The market for sequestered carbon credits is gaining interest among business, market actors as well as in research. Also, the EU is preparing for a functional carbon credit market by 2050. In the future, carbon sequestration may be covered by carbon trade or exchange and various compensation schemes. This presupposes that the long-term binding of carbon to the soil can be verified reliably. In the future, farmers could potentially also be compensated to produce other ecosystem services. New types of payment system models should be piloted quickly, as this is the only way to find realistic, viable alternatives.

Requirements for promoting regenerative agriculture

- Long-term funding for research to restore the viability of the agroecosystem
- Application of research data and development of research-advisory-farmer cooperation
- Training of advisers and the use of small advisory groups for the training and peer-learning of farmersfarmers
- Including sustainability supporting incentives for farmers in steering mechanisms such as the CAP

References

Agroecology Europe (2016). Our Understanding of Agroecology. https://www.agroecology- europe.org/our-approach/our-understanding-of-agroecology/.

Altieri, M.A., Nicholls, C.I. & Montalba, R. (2017). Technological Approaches to Sustainable Agriculture at a Crossroads: An Agroecological Perspective. Sustainability 9: 349.

Carbon Cycle Institute. Carbon Farming. http://www.carboncycle.org/wp-content/uploads/2018/09/carbon-farming-brochure-Sept2018-CCI-5.pdf

Codur, A-M. & Watson, J. (2018). Climate smart or regenerative agriculture? Defining climate policies based on soil health. Global Development and Environment Institute at Tufts University: Climate Policy Brief 9.

Ekholm, P., Reinivuo, H., Mattila, P., Pakkala, H., Koponen, J., Happonen, A., Hellström, J. & Ovaskainen, M-L. (2007). Changes in the mineral and trace element contents of cereals, fruits and vegetables in Finland. Journal of Food Composition and Analysis 20: 487–495.

FAO (2015). FAO and the 17 Sustainable Development Goals. http://www.fao.org/3/a-i4997e. pdf.

FAO Agroecology Knowledge Hub: http://www.fao.org/agroecology/home/en/

General mills Inc. (2019). Regenerative Agriculture. https://www.generalmills.com/en/ Responsibility/Sustainability/Regenerative-agriculture

Helenius, J. P., Francis, C. A., & Wezel, A. (2019). Agroecology. In Oxford Research Encyclopedias: Environmental Science Oxford University Press. https://doi.org/10.1093/ acrefore/9780199389414.013.297.

Jie, C., Jing-zhang, C., Man-zhi, T. & Zi-tong, G. (2002). Soil degradation: a global problem endangering sustainable development. Journal of Geographical Sciences 12: 243-252.

LaCanne, C.E. & Lundgren, J.G. (2018). Regenerative agriculture: merging farming and natural resource conservation profitably. PeerJ 6: e4428.

Mattila, T.J., Joona, J. & Regina, K. (2020). Cultivation methods need to be updated in order to manage the agricultural soil carbon stock. STN MULTA Policy brief 1

Park, C., & Allaby, M. (2017). A Dictionary of Environment and Conservation. 3. edition. Oxford University Press.

Puustinen, M., Tattari, S., Väisänen, S., Virkajärvi, P., Räty, M., Järvenranta, K., Koskiaho, J., Röman, E., Sammalkorpi, I., Uusitalo, R., Lemola, R., Uusi-Kämppä, J., Lepistö, A., Hjerppe, T., Riihimäki, J. & Ruuhijärvi, J. (2019). Nutrient recycling in primary production and its effects on state of surface waters, KiertoVesi Reports of the Finnish Environment Institute 22.

Regenerative Agriculture Initiative & The Carbon Underground (2017). What is Regenerative Agriculture? https://2igmzc48tf4q88z3o24qjfl8-wpengine.netdna-ssl.com/wp-content/uploads/2017/02/Regen-Ag-Definition-2.23.17-1.pdf

Regenerative Organic Alliance (2019). Framework for Regenerative Organic Certification. https://www.generalmills.com/en/Responsibility/Sustainability/Regenerative-agriculture

Rhodes, C.J. (2017). The imperative for regenerative agriculture, Science Progress 100: 80-129

Soussana, J-F. & Lemaire, G. (2014): Coupling carbon and nitrogen cycles for environmentally sustainable intensification of grasslands and crop-livestock systems. Agriculture, Ecosystems & Environment Volume 190: 9-17.

Singh, R. & Singh G.S. (2017). Traditional agriculture: a climate-smart approach for sustainable food production. Energy, Ecology and Environment 2: 296-316.

Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., Biggs, R. Carpenter, S.R., de Vries, W., de Wit, C.A., Folke, C., Gerten, D., Heinke, J., Mace, G.M., Persson, L.M., Ramanathan, V., Reyers, B. & Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. Science 347.

Terra Genesis International. Regenerative Agriculture. http://www.regenerativeagriculturedefinition.com